The American Journal of Surgery 220 (2020) 1445–1450

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Elective robotic-assisted bariatric surgery: Is it worth the money? A national database analysis☆

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ARTICLE INFO

Article history:
Received 11 April 2020
Received in revised form
1 August 2020
Accepted 29 August 2020

Keywords:
Bariatrics
Minimally invasive surgery
Cost · outcomes
Opiate use

ABSTRACT

Background: This study sought to evaluate surgical outcomes, cost, and opiate utilization between patients who underwent either laparoscopic or robotic-assisted bariatric procedures, including sleeve gastrectomy (SG) or Roux-en-Y gastric bypass (RYGB).
Methods: The Vizient administrative database was queried for patients admitted with mild to moderate severity of illness scores who underwent elective laparoscopic (L) and robotic-assisted (R) SG or RYGB from October 2015 through December 2018. Patients were grouped according to surgical approach for each bariatric procedure. Rates of overall complications, mortality, 30-day readmission, LOS, total direct cost, and opiate utilization were collected. Comparisons were performed within each bariatric procedure, between laparoscopic and robotic approaches, using IBM SPSS v.25.0, $\alpha = 0.05$.
Results: For SG, a total of 84,034 patients were included (LSG:N = 78,405; RSG:N = 5639). There was no significant difference in rates of overall complications (LSG:0.5%, RSG:0.4%; p = 0.872), mortality (LSG:<0.01%, RSG:<0.01%; p = 0.660), and 30-day readmissions (LSG: 0.5%, RSG:0.5%; p = 0.524). Average LOS was 1.65 ± 1.07 days for LSG and 1.77 ± 1.29 days for RSG (p=<0.001). Robotic approach had a significantly higher direct cost (LSG: $6505 ± 3,200, RSG: $8018 ± 3849; p=<0.001). Rate of opiate use was 97.3% for both groups (p=>0.05). For RYGB, 36,039 patients met the inclusion criteria (LRYGB:N = 33,053; RRYGB:N = 2986). There was no significant difference in rates of overall complications (LRYGB: 1.4%, RRYGB:1.3%; p = 0.414) or mortality (LRGYB:<0.01%, RRYGB: <0.01%; p = 0.646). Robotic approach was associated with a lower 30-day readmission rate (LRYGB: 1.3%, RRYGB:<0.01%; p=<0.001). Average LOS was 2.1 ± 2.18 days for LRYGB and 2.18 ± 3.78 days for RRYGB (p = 0.075). Robotic approach had a significantly higher direct cost (LRYGB:$8564 ± 5,350, RRYGB: $10,325 ± 7689; p=<0.001) and rate of opiate use (LRYG:95.75%, RRYGB:96.85%; p = 0.005).
Conclusion: Our study found the direct cost of RSG to be significantly higher than LSG with no added clinical benefit, therefore, universal use of the robotic platform for routine SG cases remains difficult to justify. While the direct cost of RRYGB was also higher than LRYGB, the significantly lower readmission rate associated with robotic approach may help to offset the financial discrepancy and warrant its use.

Introduction

Obesity is a worldwide problem affecting a large percent of the population, some estimates as high as 2-billion. Despite the development of several modalities of medical management, surgical management of obesity has shown the greatest reliability in achieving sustained weight loss and resolution of obesity-related co-morbidities.[1,2] Sleeve gastrectomy (SG) and roux-en-y gastric bypass (RYGB) are the most commonly performed bariatric procedures. Laparoscopic sleeve gastrectomy (LSG) and laparoscopic roux-en-y gastric bypass (LRYGB) are efficacious operations with a 5-year estimated mean percentage excess weight loss of 49% and 57%, respectively.[3] Approximately 39.8%, or roughly 93 million, Americans have a BMI ≥35 [4]; therefore, the 228,000 bariatric procedures completed (in 2017) is less than 0.03% of qualifying patients. Primary bariatric surgery has a low reported mortality rate of 0.1–1.1%, making it a safe tool in combating the obesity epidemic.[5,6]

☆ **Disclosures:** PRA declares receiving NIH grant through IDeA-CTR non-related to the current work. The remaining authors have nothing to disclose.

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https://doi.org/10.1016/j.amjsurg.2020.08.040
0002-9610/

The advent of laparoscopic technology conveyed several benefits including decreased surgical morbidity, recovery and hospital stay when compared to open procedures. Laparoscopic capabilities and availability continued to grow, further promoting its widespread adoption. In 1993, the first LRYGB was described. A minimally invasive approach quickly became the standard of care within bariatrics.[7]

Despite an overall improvement in clinical outcomes, laparoscopy does have several technical limitations for the surgical team. Images are 2-dimensional and visualization of the surgical field is dependent on the skill level of the surgical assistant managing the camera and tissue retraction for adequate exposure. Additionally, the laparoscopic instruments have no reticulating capacity in small spaces, thereby losing an axis of movement altogether.[8] The ergonomic challenges innate to laparoscopy are exacerbated in the setting of obesity.[9] Repetitive musculoskeletal injury can ultimately result in chronic pain, suffering, loss of surgical ability, and even worsened patient outcomes.[10]

Since gaining FDA approval in 2000, use of the robotic platform within the field of general surgery continues to expand. Utilization of the robotic platform allows the surgeon to control camera angles and optimize exposure with multiple wristed instruments. These technical advancements are particularly helpful in patients with obesity, given associated challenges of increased torque on ports from a thick abdominal wall and decreased working space from increased intra-abdominal fat and liver size.[11] Reticulation of robotic arms allows for increased surgical precision in tight spaces. The robotic platform utilizes high-resolution cameras to provide immersive stereoscopic vision that improves depth perception and overall visualization compared to the conventional laparoscope.[12]

Technological benefits notwithstanding, the transition from laparoscopic to robotic approach for minimally invasive bariatric surgery has not had the same velocity as its predecessor. Robotic assistance has been widely quoted to be more expensive than laparoscopy, with several studies reporting no difference in clinical outcomes, thus promoting continued use of laparoscopic approach.[13] The lack of transparent and granular cost data currently available severely limits a surgeon's ability to identify areas of potential cost savings to justify use of the robotic platform. As concern over the growing opioid crisis continues to grow, bariatric surgeons are proactively identifying clinical and technical factors that influence rates of post-operative opiate use. To this end, the selection of minimally invasive surgical approach on postoperative pain remains unclear. Our study aimed to compare clinical outcomes, rate of opiate use, and direct cost breakdowns between laparoscopic and robotic approach for the two most commonly performed bariatric operations, sleeve gastrectomy (SG) and roux-en-y gastric bypass (RYGB) using a large, validated administrative database.

Methods

Database description

The Vizient Clinical Database (CDB) is an administrative health care analytics platform that compiles procedure-based supply utilization and cost information, in addition to patient outcomes data – such as LOS, hospital-acquired conditions, complication and morality rates. Data is collected from 97% of academic medical centers, greater than 50 healthcare systems, and more than 400 community hospitals across the United States. In total, over 6 million inpatient and 86 million outpatient visit data submissions are recorded per year. Comparisons can be made within and between participating healthcare systems.

The Vizient clinical database resource manager (CDB/RM) uses a validated clinical algorithm to calculate each patient's severity of illness (SOI) score which takes into consideration demographic information, major diagnoses on admission, and presence or abscess of 29 comorbidities. The SOI score is then used to classify patients into minor, moderate, major, or extreme severity groups. Ratio of cost-to-charge (RCC) methodology is utilized to calculate the cost of patient care along service lines. Logistic regression models are applied for risk adjustment outcomes. The methodology for data collection and commuting for the Vizient CDB/RM has been described in several prior publications authored by our group.[14-16]

Study population

The Vizient clinical database resource manager (CDB/RM) was queried for patients older than 18 years who underwent elective laparoscopic (L) and robotic-assisted (R) SG or RYGB from October 2015 through December 2018. This is an administrative, de-identified database that comprises data from over 300 academic and affiliate hospitals in the United States. Details of the database have been previously published by us.[14-16] The query for the current study was performed according to ICD-10-CM diagnosis codes for obesity (E66, E660, E6601, E6609, E662, E668, E669, E661, Z683, Z6830, Z6831, Z6832, Z6833, Z6834, Z6835, Z6836, Z6837, Z6838, Z6839, Z684, Z6841, Z6842, Z6843, Z6844, Z6845) and ICD-10-CM procedures codes for LSG (0DB64Z3) and LRYGB (0D164ZA, 0D168ZA). Robotic-assisted procedures were queried by using one code for the laparoscopic approach in addition to one of the robotic ICD-10-CM codes (8E0W3CZ, 8E0W4CZ, 8E0W8CZ, 8E0WXCZ). In an effort to standardize our cohorts, we only included patients who were classified as minor or moderate SOI. This retrospective review of a de-identified database was not classified as human subjects research, hence, IRB approval was not required.

Variables of interest

Data was collected on patient's age, gender, and race. Outcomes measured included intra- and postoperative morbidity and mortality, use of opiates, and length of hospital stay (LOS). The overall 30-day postoperative complication rate is calculated by tracking the total number of cases of thirteen medical-surgical complications including stroke, aspiration pneumonia, gastrointestinal hemorrhage, myocardial infarction, adverse events due to anesthesia, plus four classifications of post-operative infections and four indications for hospital readmission. Cost information, including total direct cost of the encounter, was collected. This data was further subcategorized within service lines, reporting mean cost of accommodations, medical surgical supplies, and surgical services. Opiate utilization and corresponding costs are estimated using the assumed average maintenance dose per day for an adult (defined daily dose), as well as the total number of units for a selected resource billed in this group (total resource units used). The approach and limitations of this methodology and data collection has been previously outlined by Armijo et al.[14]

Statistical analysis

Patients were grouped according to surgical approach (L vs R) for each bariatric procedure (SG or RYGB). Categorical data was expressed as frequency, whereas continuous data was expressed as mean and standard deviation or median and interquartile range, according to data distribution. Comparisons were performed within each bariatric procedure, between laparoscopic and robotic-assisted approaches, using IBM SPSS v.26.0, $\alpha = 0.05$.

Results

Sleeve gastrectomy

A total of 84,034 patients underwent SG from October 2015 through December 2018 and met the inclusion criteria for the study (LSG: N = 78,405; RSG: N = 5639). Patient's age in both the groups were comparable (LSG = 43.7 ± 11.99; RSG = 43.1 ± 11.67). There was a predominance of female patients in the RSG group compared to LSG (81.3% vs 79.1%; $p < 0.001$). Additional demographic information is outlined in Table 1.

Surgical outcomes were largely comparable between the two SG groups, as depicted in Table 2. There was no significant difference in overall complications (LSG = 0.5%, RSG = 0.4%; p = 0.872), mortality (LSG = 0%, RSG = 0%; p = 0.66) and 30-day readmissions (LSG = 0.5%, RSG = 0.5%; p = 0.524). The average LOS was higher in the RSG group (LSG = 1.65 ± 1.07, RSG = 1.77 ± 1.29; $p < 0.001$). Similarly, total direct cost was higher in the RSG group (LSG = $6505 ± 3,200, RSG = $8018 ± 3849; $p < 0.001$). Details of the cost breakdown of intraoperative, perioperative and surgical supplies costs is outlined in Table 3.

The number of patients who required opioid administration was similar between the two SG groups (LSG = 97.3%, RSG = 97.3%; $p > 0.05$). Rates of Vizient complications including aspiration pneumonia (p = 0.101), GI hemorrhage (p = 0.563), hospital acquired acute MI (p = 0.308), anesthesia related adverse events (p = 0.581), postoperative infections (p = 0.064), postoperative shock (p = 0.567), and hospital acquired *c.diff* enteritis (p = 0.385) were comparable between the two SG groups.

Roux-en-y gastric bypass

A total number of 36,039 patients underwent RYGB from October 2015 through December 2018 and met the inclusion criteria for the study (LRYGB = 33,053; RRYGB = 2986). The mean age of patients in the RSG group was slightly higher than that of the LSG group (LRYGB = 45.2 ± 11.71 vs RRYGB = 46.1 ± 11.75; $p < 0.001$). There was no statistical difference in gender amongst the groups (LRYGB = 18% male, 82% female; RRYGB = 17.8% male, 82.2% female; p = 0.773). Additional demographic information for both RYGB groups is outlined in Table 4.

As shown in Table 5, surgical outcomes were also largely similar between surgical approaches for RYGB. There was no significant differences in overall complications (LRYGB = 1.4%, RRYGB = 1.3%; p = 0.414) or mortality (LRYGB = 0%, RRYGB = 0%; p = 0.646). 30-day readmission was significantly higher in LRYGB group (LRYGB = 1.3%, RRYGB = 0%; $p < 0.001$). Unlike SG, there was no significant difference in LOS between the two groups (LRYGB = 2.1 ± 2.18 days, RRYGB = 2.18 ± 3.78; p = 0.075). Similarly to SG, there was a significant difference in total direct cost with higher cost associated with robotic approach (LRYGB = $8564 ± 5,350, RRYGB = $10,325 ± 7689; $p < 0.001$). Details of the price breakdown of intraoperative, perioperative and surgical supplies costs is outlined in Table 6.

For RYGB, the percentage of patients who required opioid administration was comparable with no significant difference between the two groups (LSG = 95.75%, RSG = 96.85%; p = 0.005). The incidence of postoperative GI hemorrhage was significantly higher with laparoscopic approach (LRYGB = 0.6% vs RRYGB = 0.3%; p = 0.020). Rates of Vizient complications including aspiration pneumonia (p = 0.204), hospital acquired acute MI (p = 0.708), anesthesia related adverse events (p = 0.193), postoperative infections (p = 0.362), postoperative shock (p = 0.520), and hospital acquired *c.diff* enteritis (p = 0.198) were similar for patients undergoing RYGB via laparoscopic or robotic approach.

Discussion

Over the past decade, numerous studies have reported no significant difference in morbidity and mortality when comparing laparoscopic versus robotic approach for common general and bariatric surgical procedures.[9,17,18] Results of our study also indicate largely comparable outcomes between laparoscopic and robotic approach for SG and RYGB. Specifically, there was no significant increase in overall complications or morbidity for robotic groups compared to conventional laparoscopy.

Even though robotic bariatric surgery (RBS) has been deemed a safe alternative to laparoscopy, the lack of observed clinical benefit with consistently higher cost has deterred its widespread adoption.[19,8,20,21] In an effort to assess the economic impact of the robotic platform on RYGB outcomes, Hagen et al. analyzed the overall cost including amortization of the cost to purchase the robotic system and the additional hospital costs generated in the management of surgical complications. After accounting for a significantly lower rate of anastomotic leak associated with the robotic approach (RRYGB 0% vs LRYGB 4%), the authors concluded that RRYGB can be cost effective because of a reduction of costly anastomotic complications after robotic procedure.[22] Similarly, we were able to identify two potential clinical and cost-saving benefits of RRYGB, including a decreased incidence of postoperative GI hemorrhage (0.3% vs 0.6%; p = 0.020) and lower rate of 30-day readmission (<0.01% vs 1.3%; $p < 0.001$).

For SG, we found that the robotic approach cost approximately $1500 more than laparoscopic approach (LSG = $6505 ± 3,200, RSG = $8018 ± 3849; $p < 0.001$). Similarly, use of the robotic platform for RYGB cost approximately $1750 more than laparoscopy (LRYGB = $8564 ± 5,350, RRYGB = $10,325 ± 7689; $p < 0.001$). These findings are slightly less than what we expected, given that the current average variable cost associated with use of the robotic platform is $1600-3,200.[23] Ultimately, there are several factors contributing to the increased cost of robotic surgery, including use of semi-disposable instruments, increased length of OR time and duration of hospitalization.[20,4,21]

As expected, we found that the cost of implants and supplies was much higher for both SG (Lap = $1524 vs Robot = $2427) and RYGB (Lap = $1741 vs Robot = $2640). Within Vizient, the cost of "surgical services" includes costs of anesthesia, operating room,

Table 1
Sleeve gastrectomy patient demographics by surgical approach.

		LAP (N = 78,405)	ROBOT (N = 5629)	p-value
Age (mean ± SD)		43.7 ± 11.99	43.1 ± 11.67	<0.001
Sex (N)	Male	16,362 (20.9%)	1050 (18.7%)	<0.001
	Female	62,043 (79.1%)	4579 (81.3%)	
Race	Caucasian	47,565 (60.7%)	2993 (53.2%)	<0.001
	Other	30,840 (39.3%)	2636 (46.8%)	
	African-American	18,190 (23.2%)	1935 (34.4%)	

SD standard deviation.
LAP Laparoscopic *ROBOT* Robotic.

Table 2
Sleeve gastrectomy outcomes by surgical approach.

	LAP (N = 78,405)	ROBOT (N = 5629)	p-value
Overall Complications (N)	360 (0.5%)	25 (0.4%)	0.872
Mortality (N)	6 (0%)	0 (0%)	0.660
30 Day Readmission (N)	359 (0.5%)	26 (0.5%)	0.524
LOS (days)	1.65 days (SD 1.07)	1.77 days (SD 1.29)	<0.001
Total Direct Cost ($)	$6505 (SD $3200)	$8018 (SD 3849)	<0.001
Used opiate, N (%)	76,288 (97.3%)	5477 (97.3%)	>0.050
Aspiration Pneumonia	33 (0%)	0 (0%)	0.101
GI Hemorrhage	74 (0.1%)	5 (0.1%)	0.563
Hospital Acquired Acute Myocardial Infarction	17 (0%)	0 (0%)	0.308
Adverse Events Due To Anesthesia	33 (0%)	2 (0%)	0.581
Post-Operative Infection	19 (0%)	4 (0.1%)	0.064
Post-Operative Shock	47 (0.1%)	3 (0.1%)	0.567
Hospital Acquired C-Diff Enteritis	6 (0%)	1 (0%)	0.385

SD standard deviation.
LAP Laparoscopic *ROBOT* Robotic.

and the recovery room. The longer mean operative time is directly associated with increased cost tied to use of the robotic platform. This is reflected in our results given the significantly higher operating room costs associated with robotic approach (RSG = $4466 vs LSG = $2029; RRYGB = $5951 vs LRYGB = $3333) while anesthesia and recovery room costs were similar between approaches. Several studies indicate that RBS has a significantly shorter learning curve than laparoscopic bariatric surgery (LBS), with at least three studies suggesting that significantly reduced operative times can be seen with ≤35 cases.[11] With the learning curve progression, a reduction in operative time is expected.[24] When coupled with ergonomic benefits and low complication rates, this may make the use of robotic surgery more appealing.[25,26,2]

It has been proposed that robotic technology inflicts less tissue damage, thus minimizing postoperative pain and ileus, and potentially leading to a speedier recovery[4] This theory remains suboptimally studied within the field of minimally invasive bariatric surgery. A recent case series analysis comparing robotic and laparoscopic bariatric surgery collected post-anesthesia recovery times and pain scores to assess for differences in perioperative outcomes by surgical approach. Post-anesthesia recovery time, though not statistically significant, was higher for patients undergoing laparoscopic bariatric surgery (LBS). When pain scores were assessed using the analog pain scale, no difference was elicited between laparoscopic and robotic approach.[2] For SG, our results also showed no appreciable difference in the rate of opiate utilization (97.3% for both RSG and LSG; p=>0.05). We did note a statistically significant difference in rate of opiate utilization for RYGB patients, with a trend toward increased use in the robotic group (LRYG:95.75%, RRYGB:96.85%; p = 0.005). This is unlikely to be of any clinical significance, however, given the <1% difference in overall use between approaches. In terms of overall LOS, there is conflicting literature regarding the impact of robotic approach on LOS. [4,25,27] In our study, we did not observe a reduction in LOS for either RSG or RRYGB.

There are several limitations in scope of data capture with the Vizient administrative database. A prime example is differences in surgical techniques within procedural groups. While use of staple-line reinforcement (SLR) during LSG is associated with increased supply costs, the decreased rates of postoperative bleeding and reoperations without effect on leak rates are perceived benefits.[28] Alternatively, utilization of the robotic platform for SG can allow for meticulous suturing of the staple line involving only the minimum amount of the gastric wall necessary for tissue approximation.[4] To this end, several studies have reported decreased blood transfusion requirements and postoperative bleeding with robotic approach.[26,17]

Within the RYGB groups, the most clinically significant technical differences occur with use of various anastomotic techniques. Rates of complications can vary significantly between stapled (circular, linear, or robotic *EndoWrist* stapler) and hand sewn anastomotic techniques. A single-center study review of 835 LRYGB with patients undergoing a combination of hand-sewn anastomosis (HAS), linear-stapled anastomosis (LSA), or circular-stapled anastomosis (CSA) found that rates of postoperative complications including anastomotic leak, stricture, and marginal ulceration were similar between all techniques.[29] In contrast, a Swiss study performed at an accredited bariatric reference center comparing two consecutive cohorts found a significantly higher stricture rate of 15.6% in the CSA group versus 0% in the LSA group[30] A meta-analysis of seven studies found that LSA has lower rates of stricture but similar rates of marginal ulceration compared to CSA.[31]

Table 3
Mean direct cost breakdown for sleeve gastrectomy between approaches.

	LAP (N = 78,405)	ROBOT (N = 5629)<
Accommodations – General Routine Care ($)[a]	788	640
Medical Surgical Supplies ($)[a]	1524	2427
Implants	165	225
Supplies	1359	2202
Surgical Services ($)[a]	2811	5187
Anesthesia	308	299
Operating Room	2029	4466
Recovery Room	474	422
Total Cost - $ (mean, SD)*	7122	9641

LAP Laparoscopic *ROBOT* Robotic.
*p = <.001 laparoscopic versus robotic-assisted.
[a] No statistical analysis was performed due to lack of information on SD or IQR.

Table 4
Roux-en-y gastric bypass patient demographics by surgical approach.

		LAP (N = 33,053)	ROBOT (N = 2986)	p-value
Age (mean ± SD)		45.2 ± 11.71	46.1 ± 11.75	<0.001
Sex (N)	Male	5959 (18%)	532 (17.8%)	0.773
	Female	27,094 (82%)	2454 (82.2%)	
Race	Caucasian	23,131 (70%)	1929 (64.6%)	<0.001
	Other	9922 (30%)	1057 (35.4%)	
	African-American	5542 (16.8%)	617 (20.7%)	

SD standard deviation.
LAP Laparoscopic *ROBOT* Robotic.

Table 5
Roux-en-y gastric bypass outcomes by surgical approach.

	LAP (N = 33,053)	ROBOT (N = 2986)	p-value
Overall Complications (N)	465 (1.4%)	40 (1.3%)	0.414
Mortality (N)	11 (0%)	1 (0%)	0.646
30 Day Readmission (N)	434 (1.3%)	0 (0%)	<0.001
LOS (days)	2.10 days (SD 2.18)	2.18 days (SD 3.78)	0.075
Total Direct Cost ($)	$8564 (SD $5350)	$10,325 (SD $7689)	<0.001
Used opiate, N (%)	31,648 (95.75%)	2891 (96.85%)	0.005
Aspiration Pneumonia	42 (0.1%)	6 (0.2%)	0.204
GI Hemorrhage	191 (0.6%)	8 (0.3%)	0.020
Hospital Acquired Acute Myocardial Infarction	4 (0%)	0 (0%)	0.708
Adverse Events Due To Anesthesia	19 (0.1%)	0 (0%)	0.193
Post-Operative Infection	37 (0.1%)	2 (0.1%)	0.362
Post-Operative Shock	29 (0.1%)	2 (0.1%)	0.520
Hospital Acquired C-Diff Enteritis	8 (0%)	2 (0.1%)	0.198

LAP Laparoscopic *ROBOT* Robotic.
SD standard deviation.

Table 6
Mean direct cost breakdown for roux-en-y gastric bypass between approaches.

	LAP (N = 33,053)	ROBOT (N = 2986)
Accommodations – General Routine Care ($)[a]	1076	941
Medical Surgical Supplies ($)[a]	1741	2640
Implants	125	250
Supplies	1615	2390
Surgical Services ($)[a]	4459	6738
Anesthesia	615	635
Operating Room	3333	5951
Recovery Room	511	422
Total Cost - $ (mean, SD)*	9460	11,874

LAP Laparoscopic *ROBOT* Robotic.
*p = <.001 laparoscopic versus robotic-assisted.
[a] No statistical analysis was performed due to lack of information on SD or IQR.

Anastomotic leak remains an important cause of overall morbidity and mortality after bariatric procedures. Despite an overall decrease in recent years, the reported incidence after gastric bypass varies greatly in the literature from 0.1 to 8.3%.[32] A large longitudinal study of 28,616 patients report incidence of leak after LRYGB to be as low at 0.8%.[33] The robotically hand-sewn anastomotic technique has been shown to have a significantly lower leak rate of 0.3% vs 3.6% with laparoscopic stapled technique (p = 0.001).[24] Recent systematic review and meta-analysis also endorses a significant reduction in rate of anastomotic strictures among RRYGB with hand-sewn gastrojejunal anastomosis.[27] Additionally, if stapled anastomoses are widely replaced by the robotically hand-sewn technique, there will be an associated decrease in cost of supplies.

It is important to consider the impact of newer technology and upgrades of the robotic system on variability in surgical technique. The *da Vinci Xi* Surgical System first debuted in April 2014. Given that our study period spanned 2015–2018, it is likely that some users continued to use the *Si* system while others migrated to the newer platform. Unfortunately, this information is not currently tracked by MBSAQIP (clinical) nor the Vizient (administrative) databases. [9,4] While the Vizient database captures several unique and relevant metrics such as opioid use and cost data, it does lack procedure-specific complications. Additionally, reported cost data for the robotic platform likely does not include maintenance and amortization costs.

Our previous publications have outlined some of the inherent limitations of the Vizient administrative database including potential for variances in coding among participating institutions, accuracy of data input, and use of comprehensive guidelines with consistency of clinical documentation.[34] Certain data points, such as direct costs, are reported as mean averages and lack information regarding standard deviation or normality of distribution.[16] Vizient carries the designation of a validated database given a <0.1% reported rate of coding errors, with the number of participating institutions continuing to increase annually. Unfortunately, there are several data points of interest, such as BMI, that are not universally collected by this database which limits our ability to perform subanalysis to assess for additional confounding factors. As the scope of this administrative database continues to expand, we anticipate an increase in capture of clinically relevant data points.

To our knowledge, this is the largest study of a national administrative database comparing outcomes and cost between laparoscopic and robotic approach for the two most commonly performed bariatric operations, SG and RYGB. In terms of clinical outcomes, our results indicate non-inferiority of robotic approach with the potential benefits of lower rates of readmission and GI hemorrhage with RRYGB, which is largely consistent with the existing literature. Additionally, our study found that the variable costs associated with use of the robotic platform to be lower than previous estimates. This is likely due to recent increase in utilization of robotic-assisted approach and progression along the learning curve, resulting in shorter operative times, which directly contributes to down-trending cost of RBS. Further investigation and analysis of variations in surgical techniques and operative experience is also needed to determine which factors contribute to these differences and what implications they may have on future use of the robotic platform in bariatric surgery. Large multicenter randomized trials will ultimately provide level I evidence and facilitate further development of practice guidelines.

Acknowledgements

BP generated the research question and is responsible for methods, data collection, statistical analysis and writing of manuscript. SS is responsible for methods and writing of the manuscript. UY is responsible for statistical analysis and writing of the manuscript. PRA is responsible for data collection and statistical analysis. VK oversaw the project, edited the final manuscript, and is responsible for article submission.

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